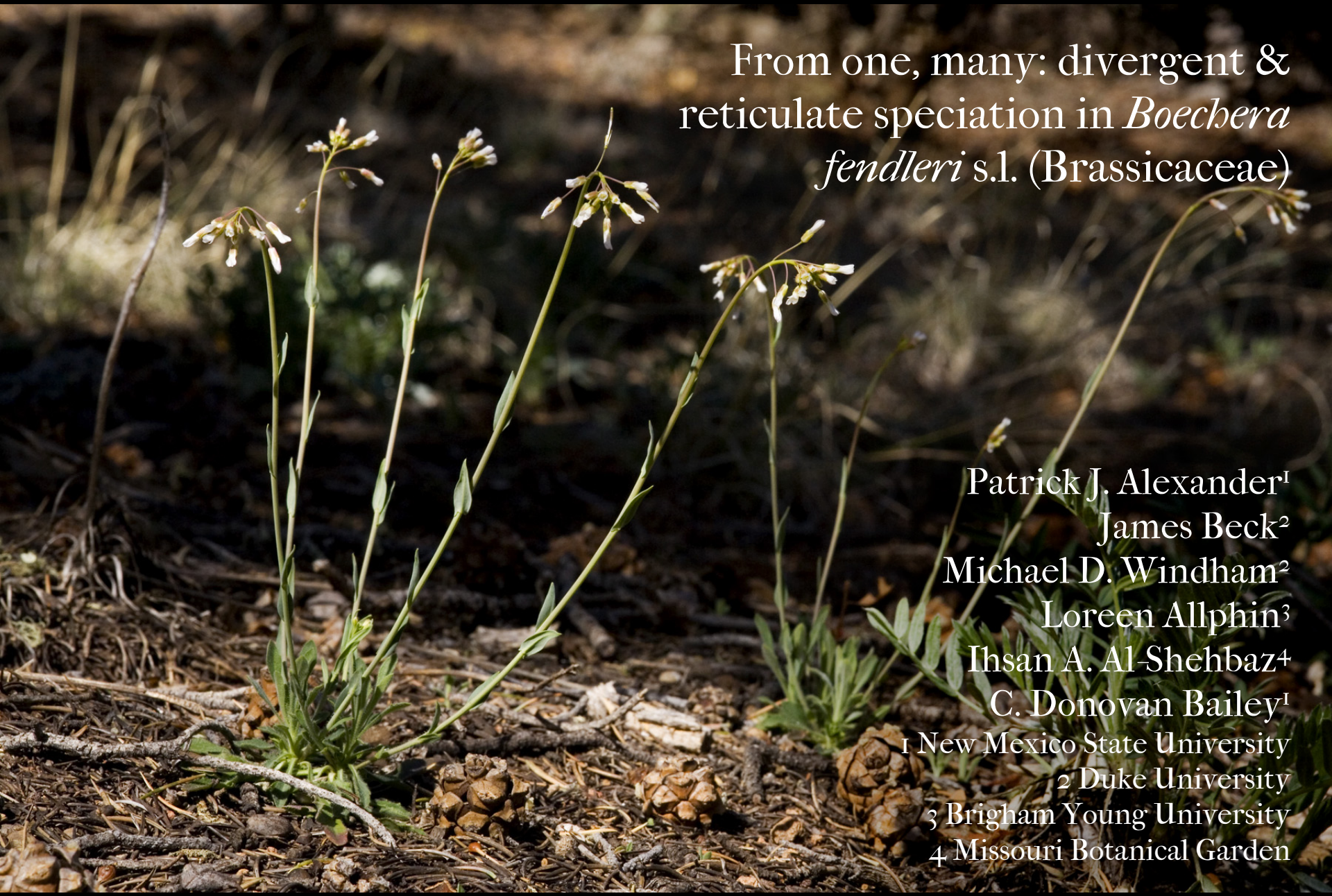

From one, many: divergent & reticulate speciation in *Boechera fendleri* s.l. (Brassicaceae)

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Brief history of *Boechera fendleri* (S.Watson) W.A.Weber

Treated by Rollins (1941, 1993) as *Arabis fendleri* (S.Watson) Greene, with two varieties:

Arabis fendleri (S.Watson) Greene var. *fendleri*
Arabis fendleri (S.Watson) W.A.Weber var. *spatifolia* (Rydb.) Rollins

Transferred to *Boechera* by Weber (1982), without varieties.

Treated by Windham & Al-Shehbaz (2006) as three species in *Boechera*:

Boechera fendleri (S.Watson) W.A.Weber
Boechera spatifolia (Rydb.) Windham & Al-Shehbaz
Boechera texana Windham & Al-Shehbaz

B. fendleri occurs primarily in New Mexico; *B. spatifolia* primarily in the Rocky Mountains in Colorado; *B. texana* in western Texas.

Brief history of *Boechera fendleri* (S.Watson) W.A.Weber

Rollins' distinctions between *fendleri* & *spatifolia*:

fendleri

- basal leaves oblanceolate, dentate
- stems usually several, arising below a terminal cluster of leaves
- petals pink

spatifolia

- basal leaves linear-oblanceolate, entire
- stems single or few, not arising below a terminal cluster of leaves
- petals white

Boechera fendleri vs. *spatifolia*: stems

Brief history of *Boechera fendleri* (S.Watson) W.A.Weber

Distinctions between *Boechera texana* and both *fendleri* & *spatifolia*:

fendleri/spatifolia

- basal leaves with simple & forked trichomes
- stems & sepals pubescent
- fruits 1.5-2.0 mm broad

texana

- basal leaves with 2- to 4-rayed trichomes
- stems & sepals glabrous
- fruits 2.5-3.0 mm broad

Boechera fendleri, & *spatifolia* vs. *texana*: siliques

Genetic evaluation of species boundaries

- Previous taxonomic hypotheses have been morphological;
- we use nuclear microsatellite data and phylogenetic analyses using nuclear loci to evaluate:

1) Are the three species recognized by Windham & Al-Shehbaz distinct?

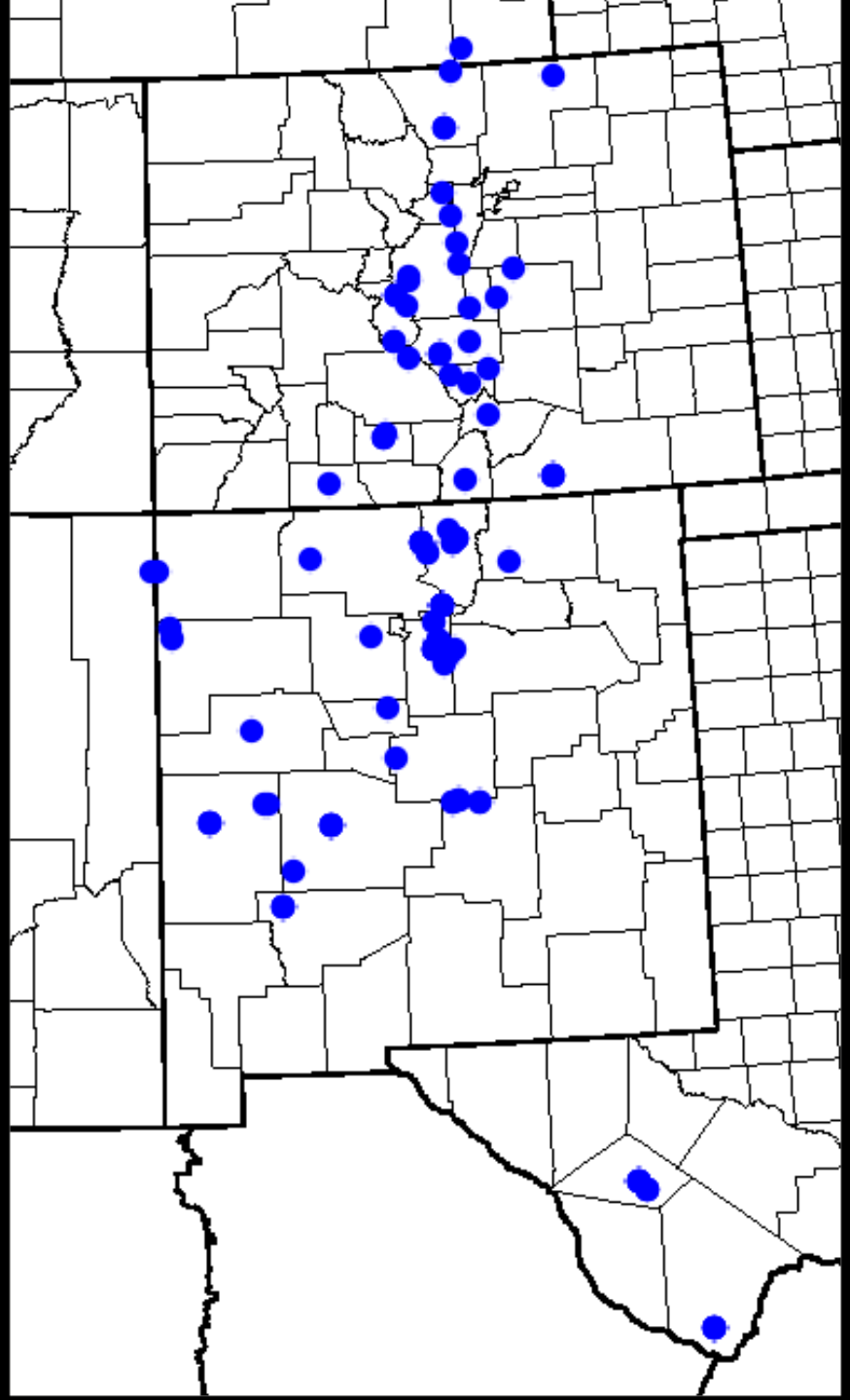
2) What is the status & origin of plants that appear intermediate between these species morphologically?

Sampling

Microsatellite analyses include 132 individuals from 69 populations (one to six individuals per population) across the range of *B. fendleri*, *spatifolia*, and *texana*.

11 nuclear microsatellites were used (from Song & Mitchell-Olds, 2007).

Phylogenetic analyses use five individuals (two of *B. fendleri* & *spatifolia*, one of *B. texana*) & sequences from eight nuclear loci.



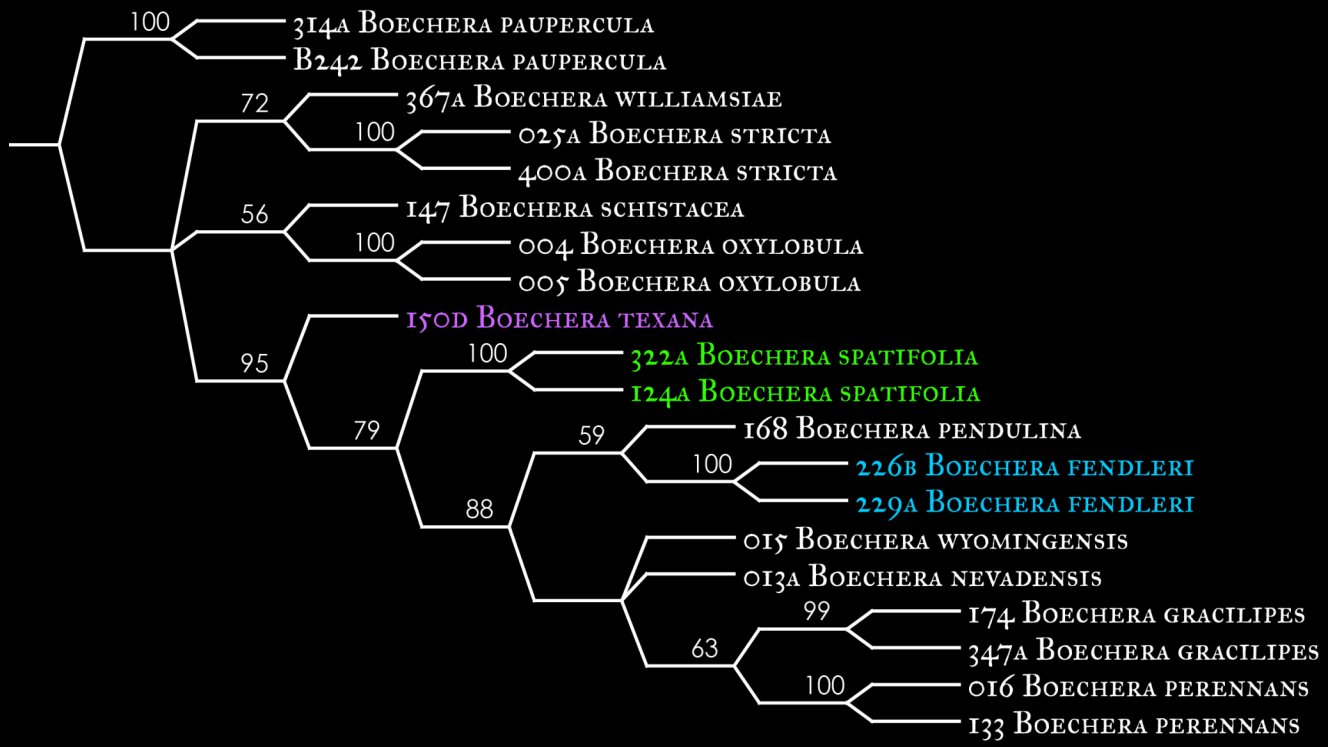
Analyses

Microsatellite data were analyzed with *structure* & AWclust:

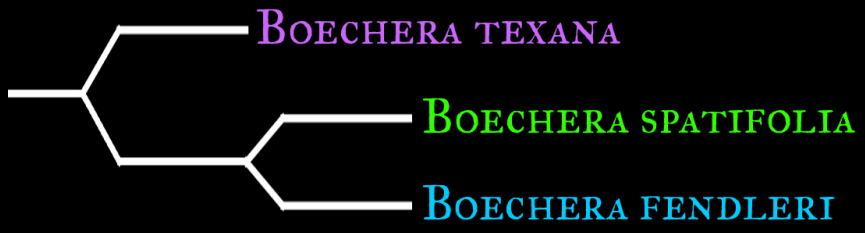
- AWclust: each allele is coded as a separate row of presence/absence data.
- *structure*: admixture model used, 50,000 burn-in generations; 1,000,000 generations after burn-in.

Phylogenies from sequence data were produced using parsimony analysis with suppor estimated from 1000 jack-knife replicates (presented in more detail on Monday).

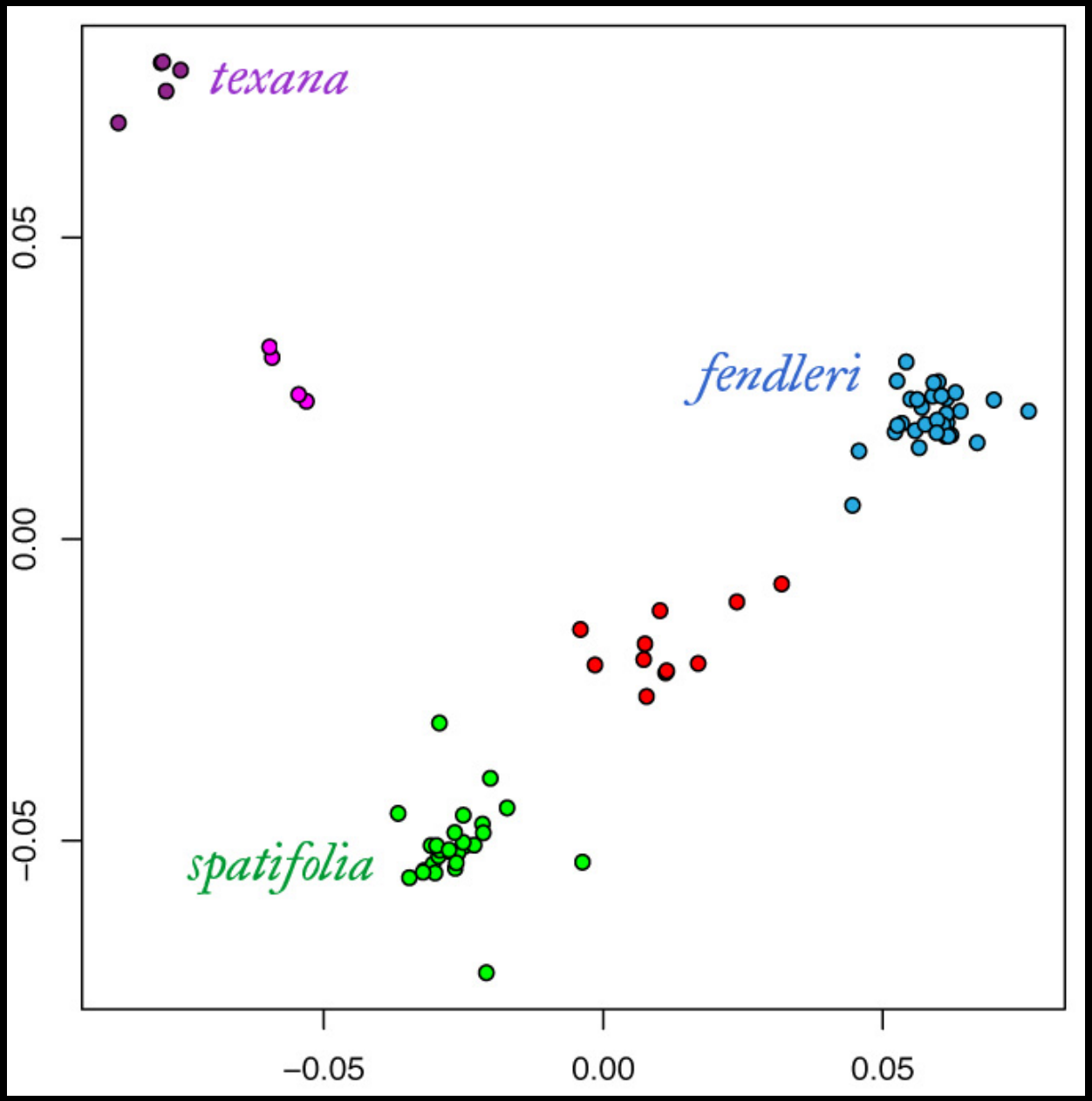
Phylogenetic analysis of eight nuclear loci:



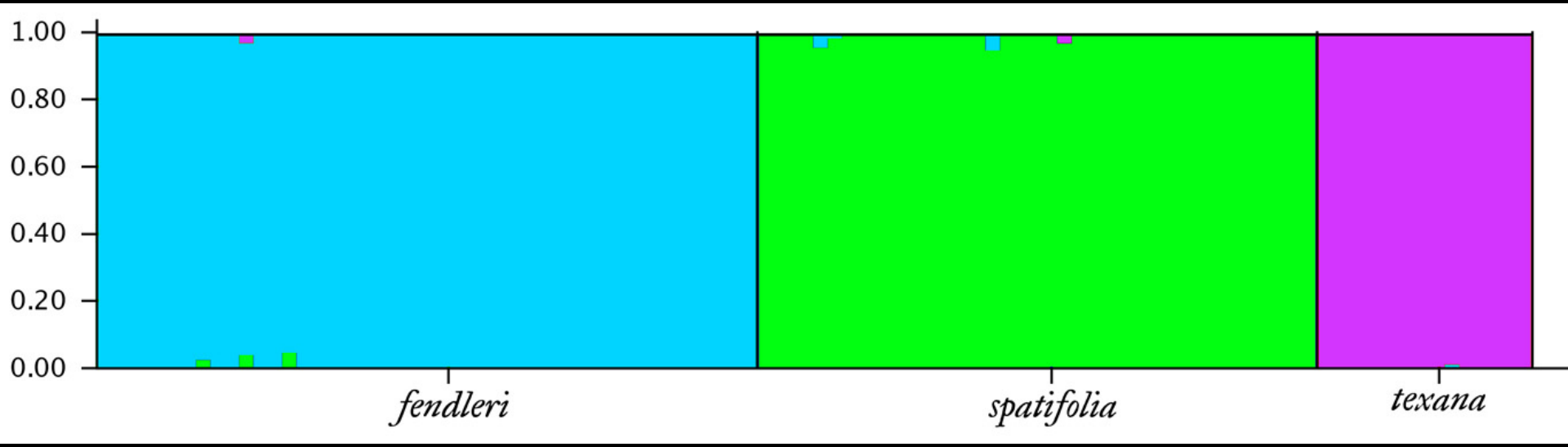
simplified:



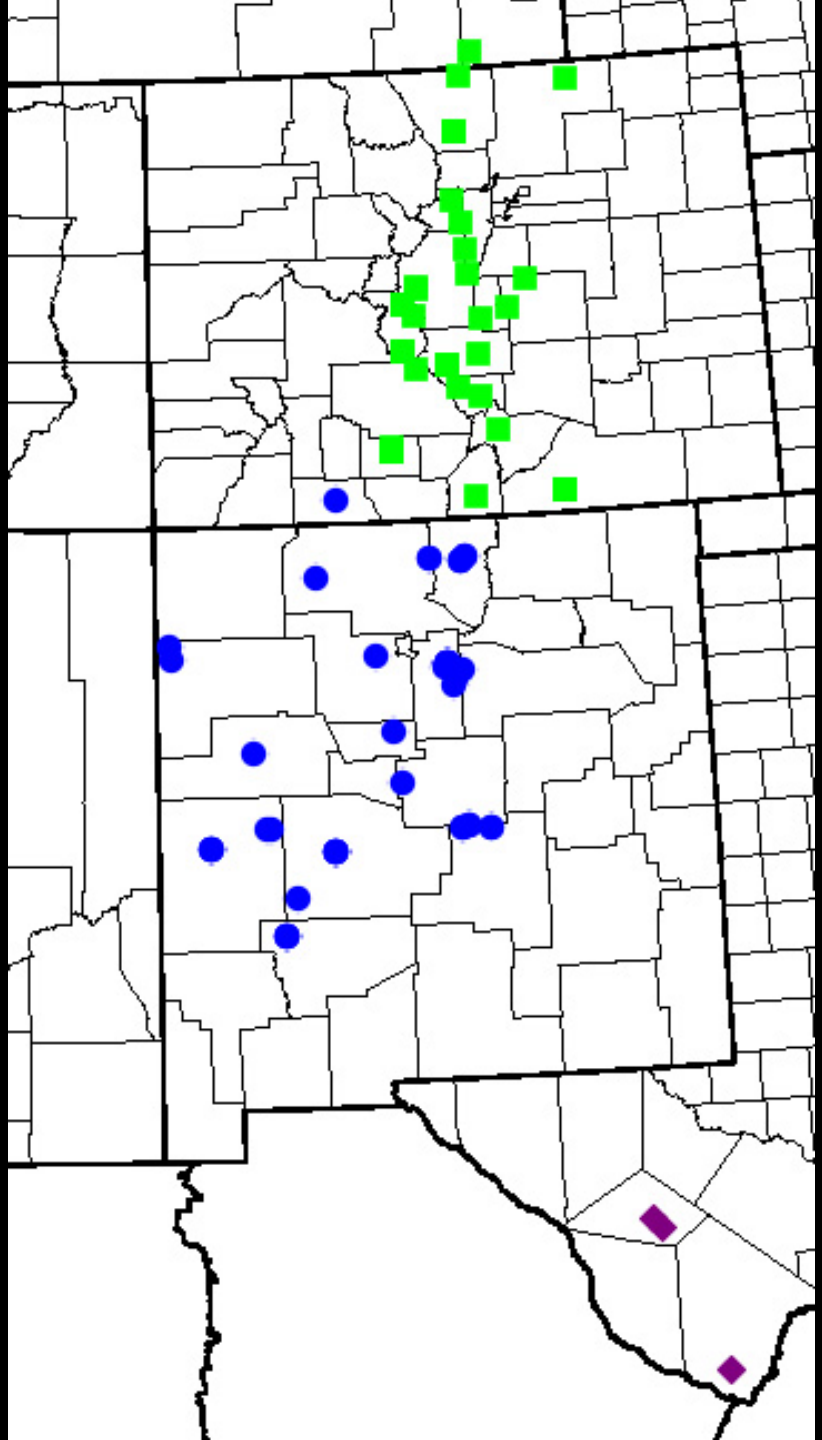
AWclust, multidimensional scaling plot



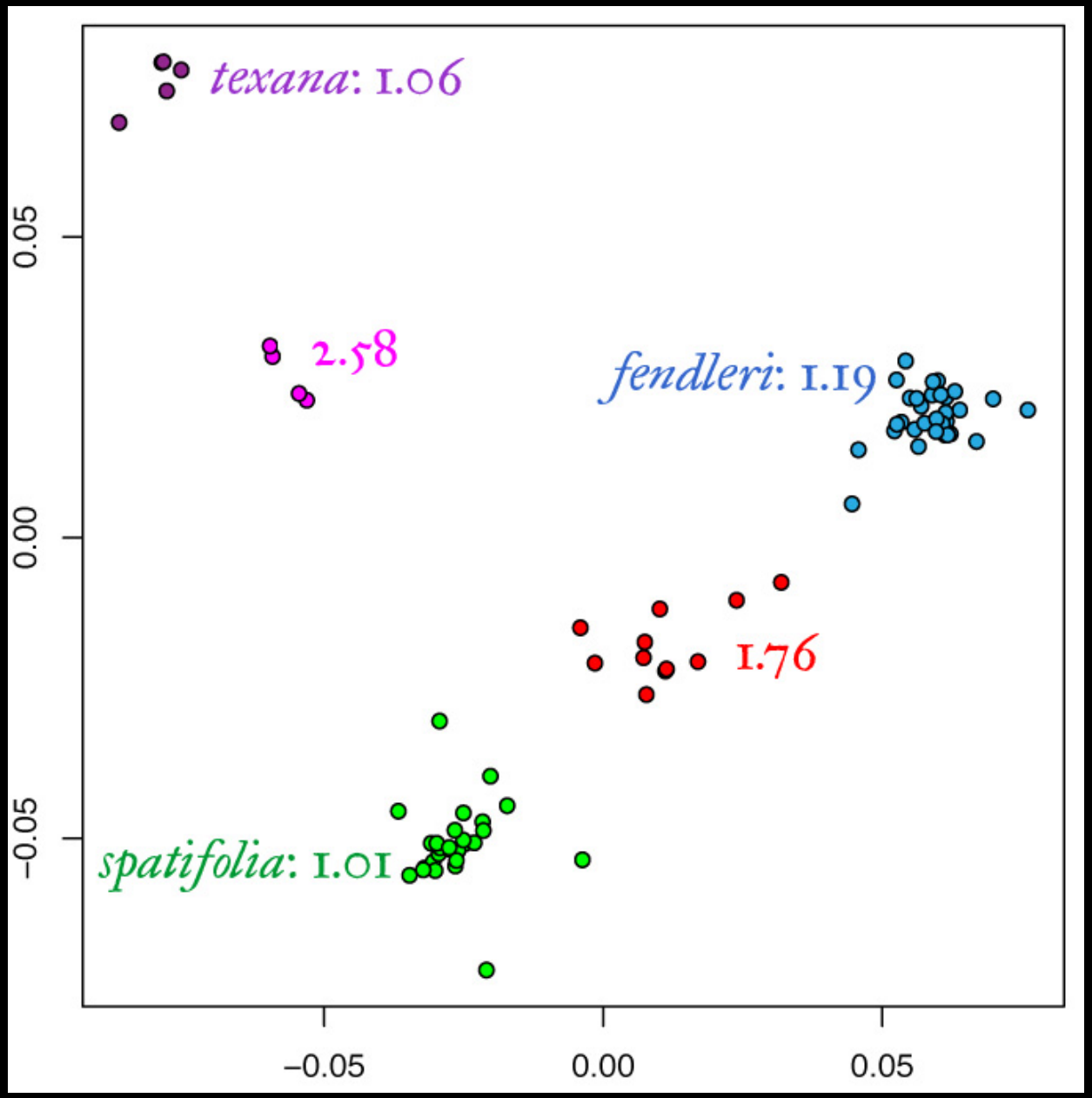
Structure; K=3, *fendleri*, *spatifolia*, & *texana* only



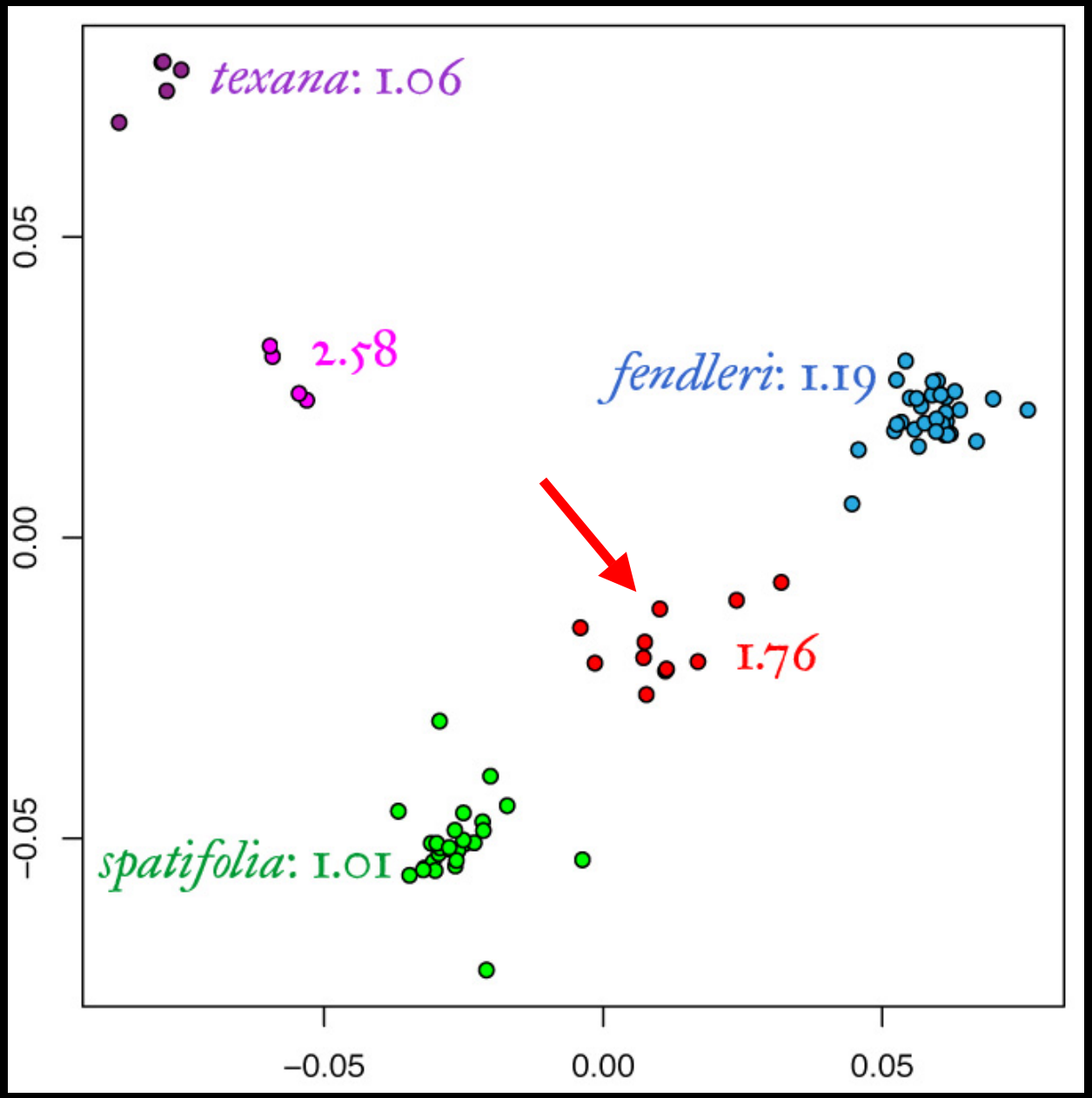
Distribution of samples;
fendleri, *spatifolia*, & *texana*



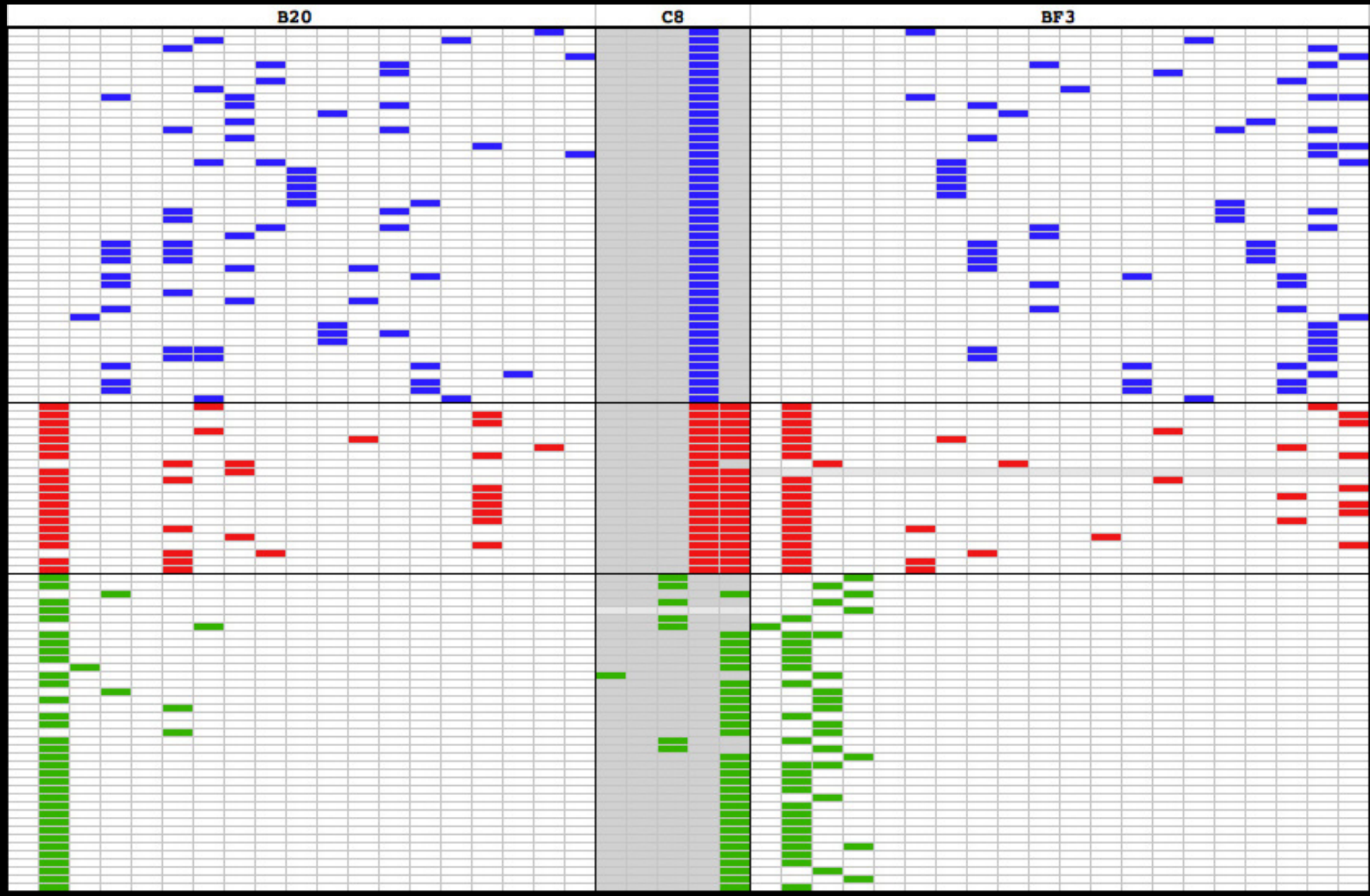
AWclust MDS plot with average number of alleles per locus



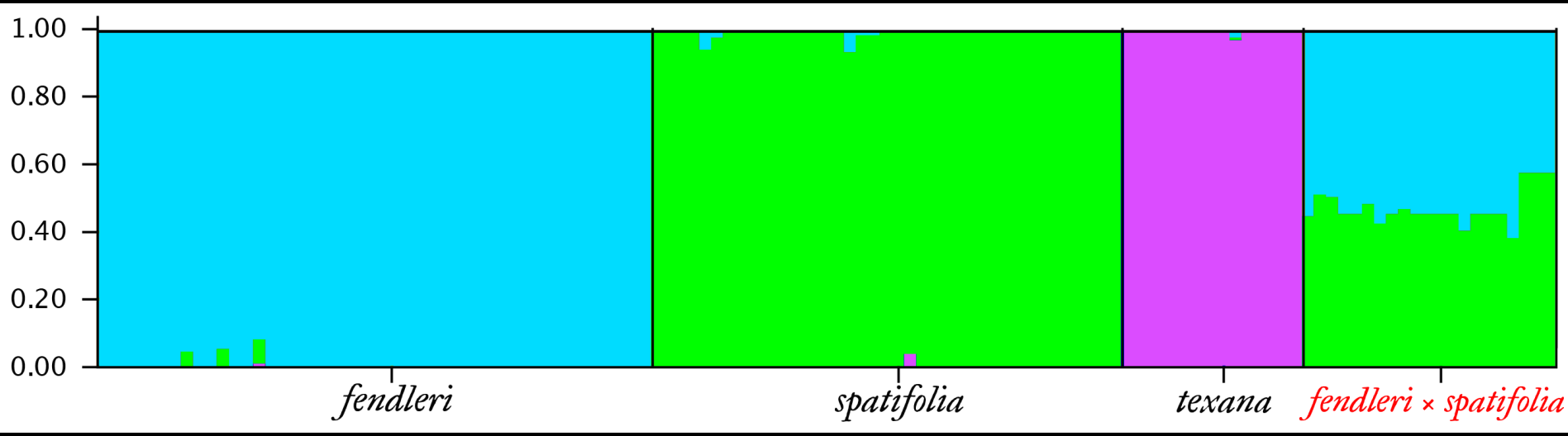
AWclust MDS plot with average number of alleles per locus



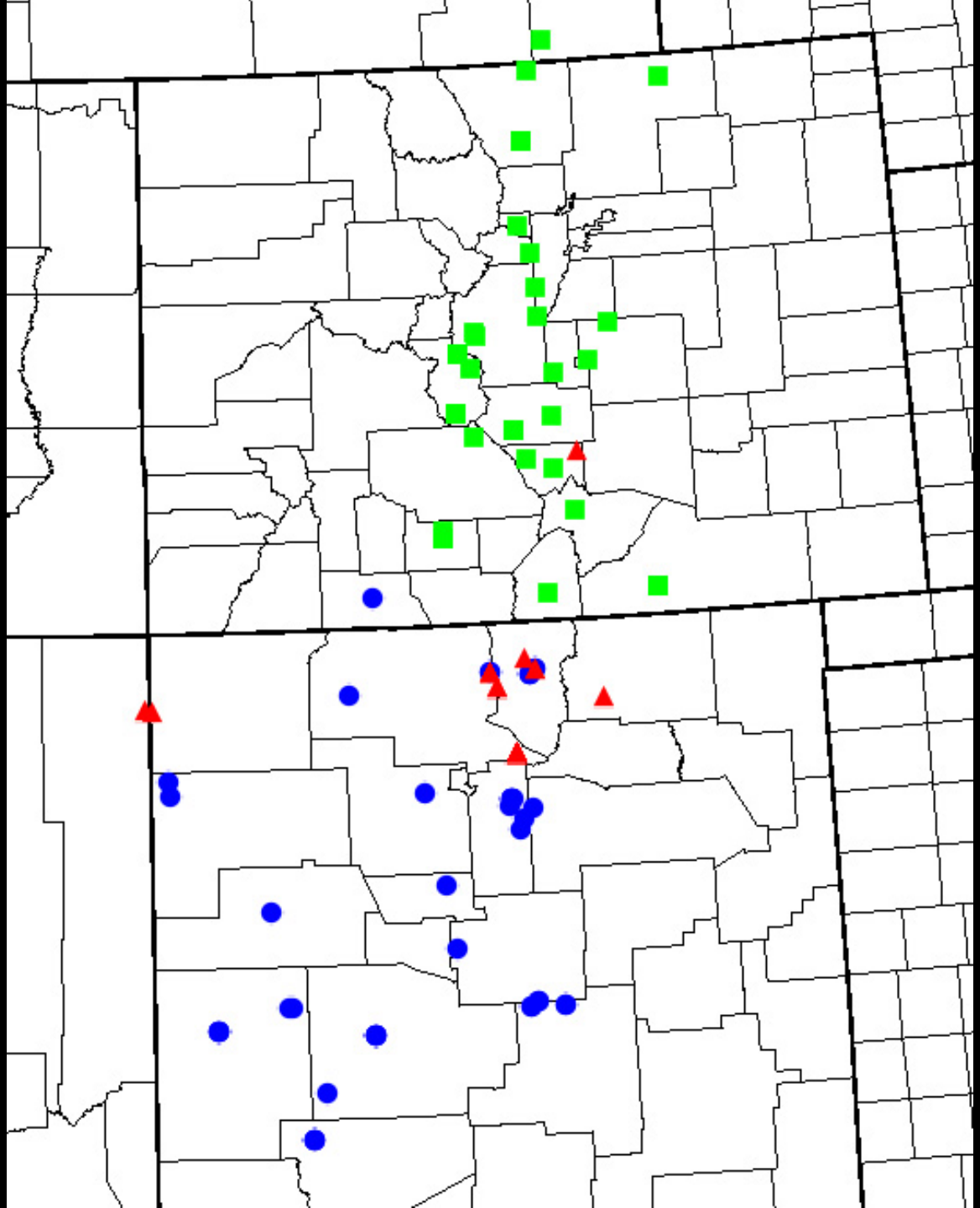
Additivity in the ‘raw’ data:



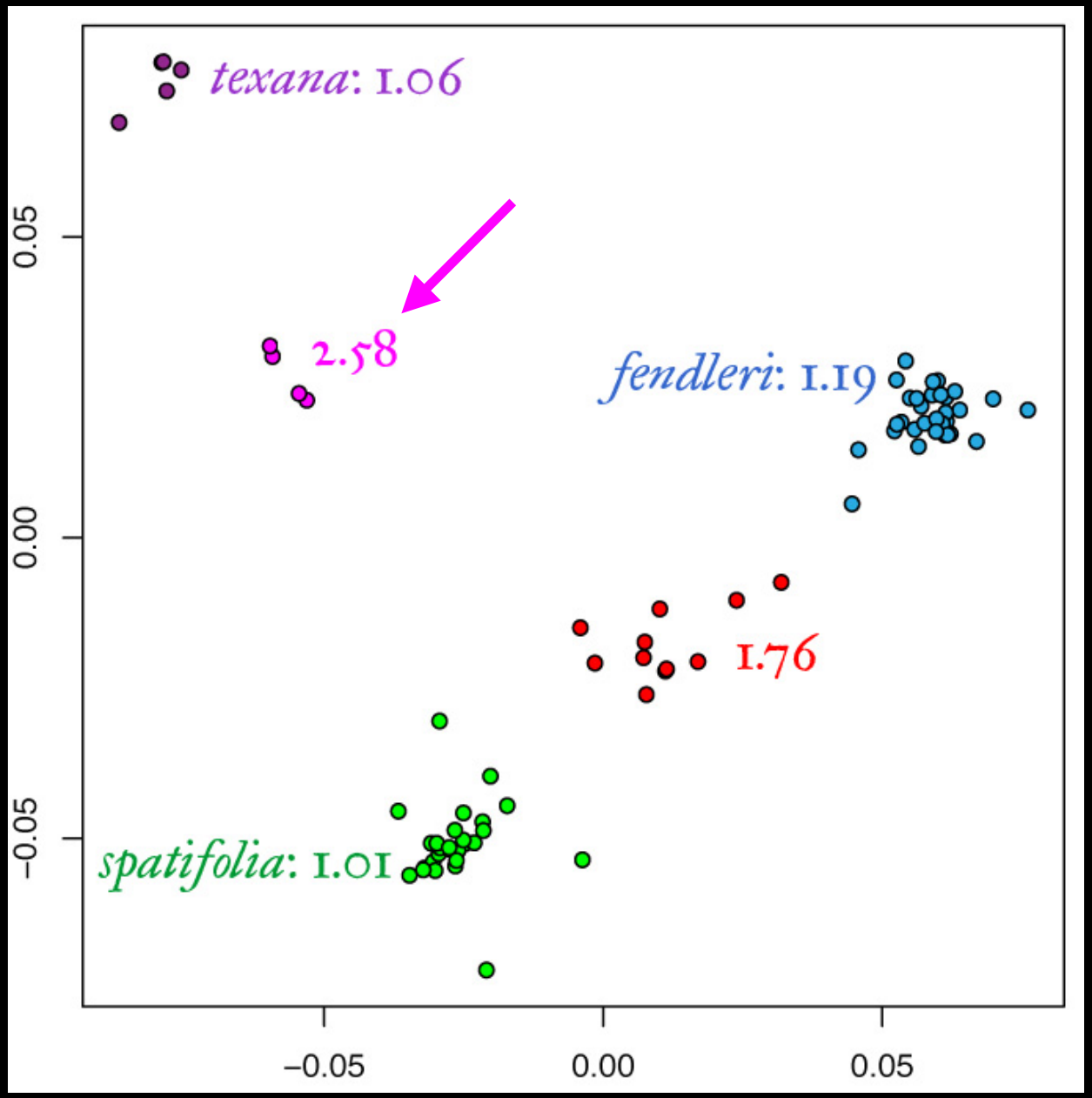
Structure; K=3, *fendleri*, *spatifolia*, *texana* & "red" individuals.



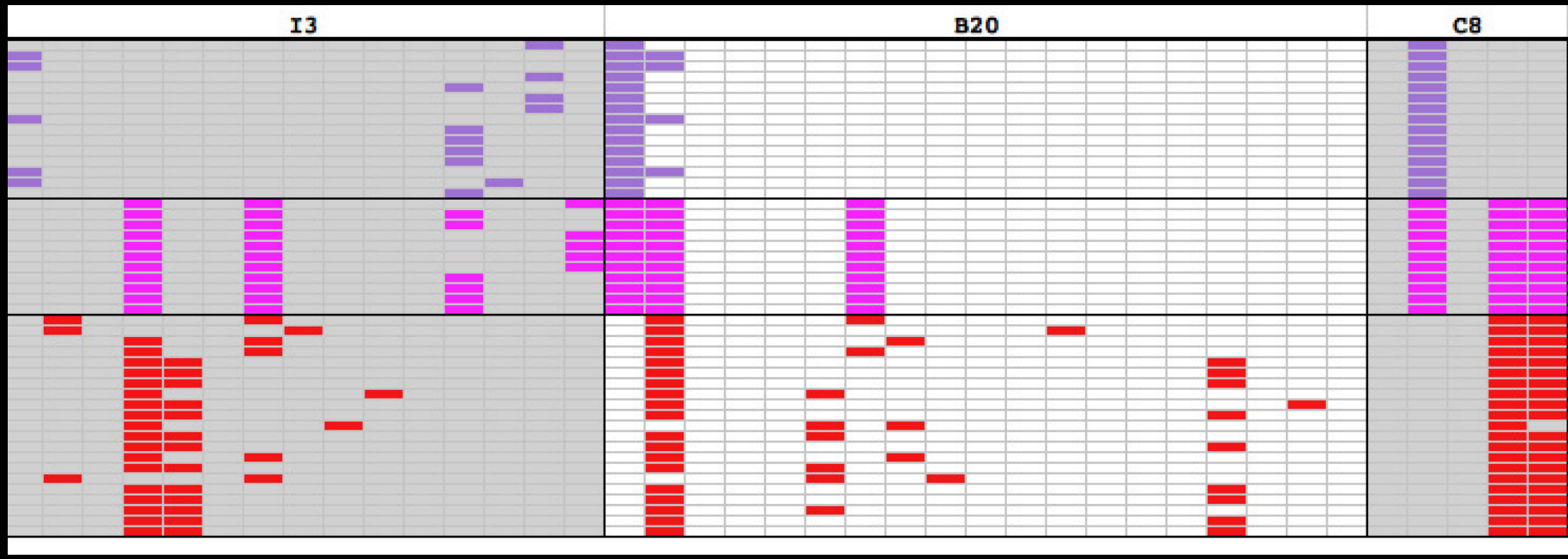
Distribution of samples;
fendleri, *spatifolia*, &
fendleri × *spatifolia* (FS)



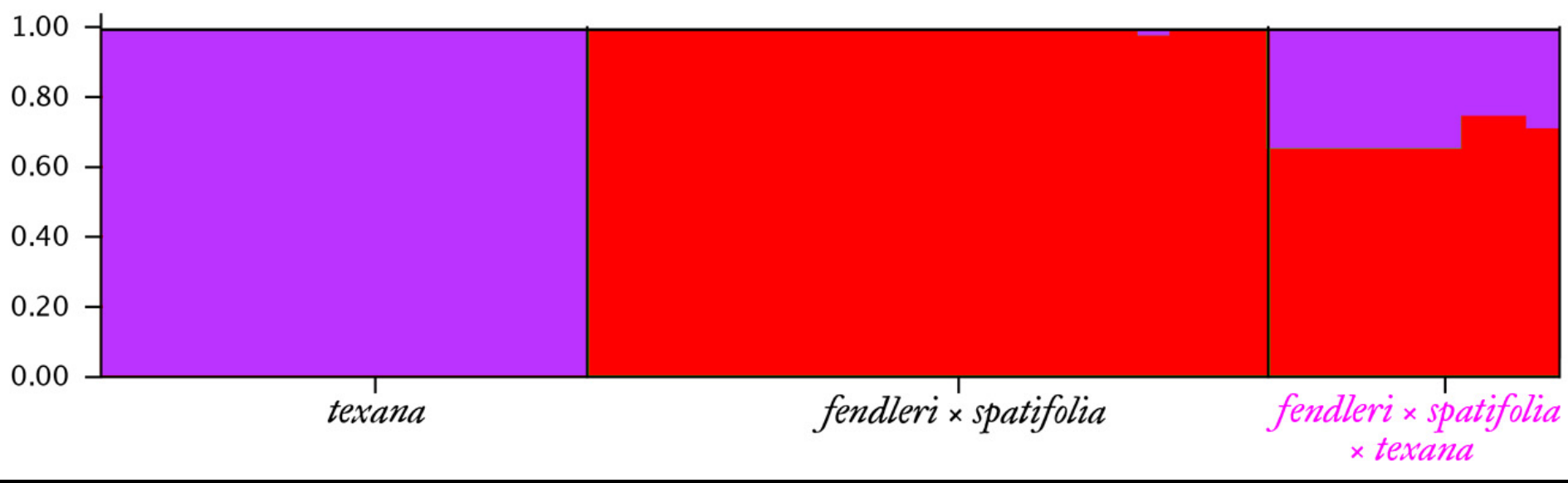
AWclust MDS plot with average number of alleles per locus



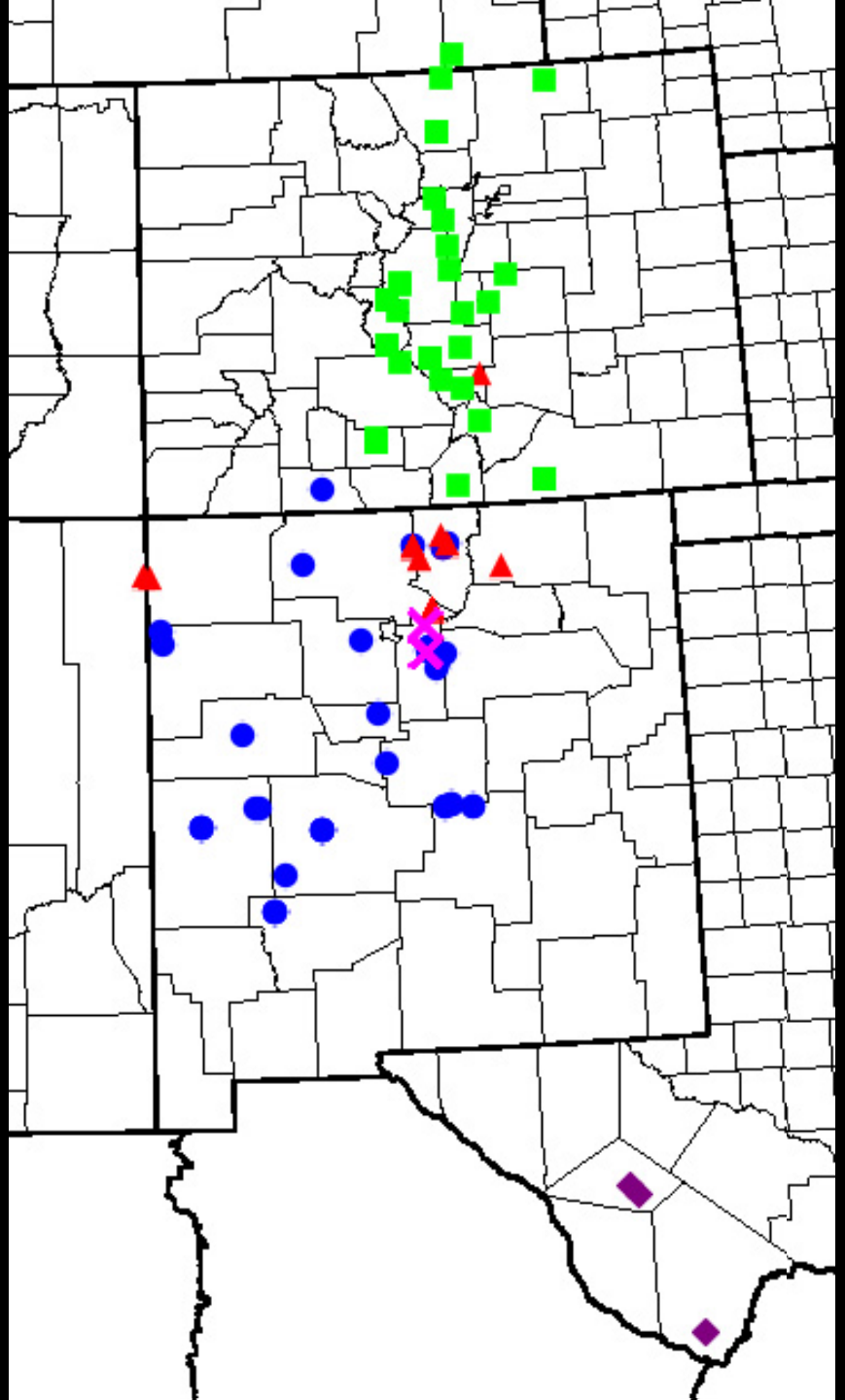
Additivity in the ‘raw’ data:



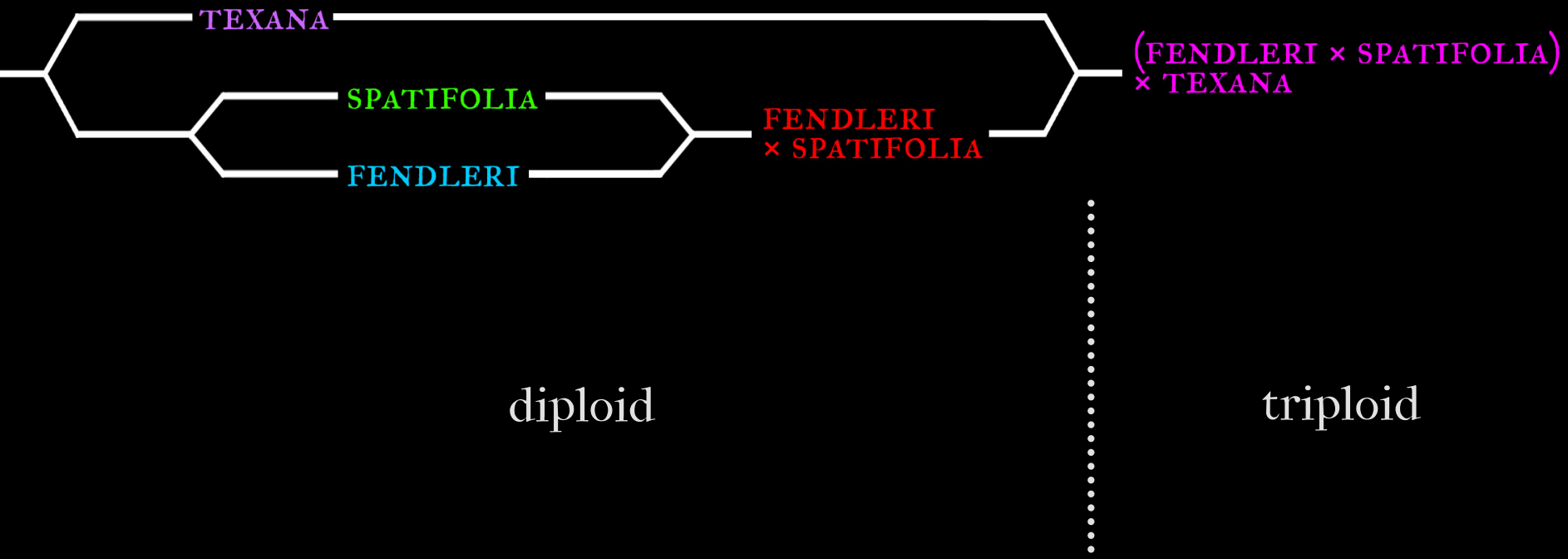
Structure; K=2, *fendleri* × *spatifolia* (FS), *texana*, & "*magenta*" individuals



Distribution of samples;
fendleri, *spatifolia*, *texana*,
fendleri × *spatifolia* (FS), &
(*fendleri* × *spatifolia*) × *texana*
(FST)



Put the phylogeny & microsatellite together, and:



• ploidy estimates from allele number are also consistent with pollen morphology (Windham & Al-Shehbaz 2006)

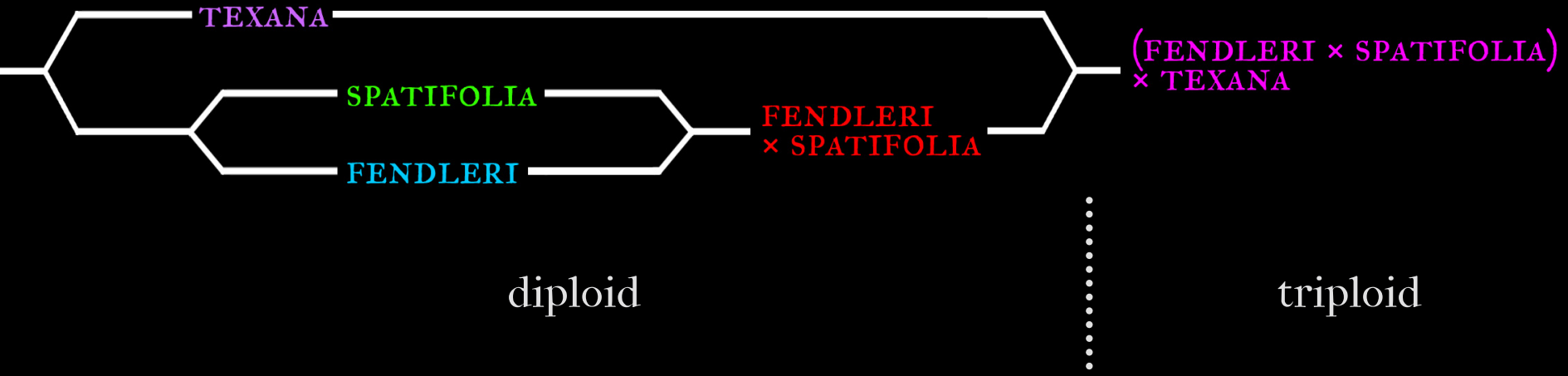
Morphology: *fendleri* × *spatifolia* (FS)

- plants either resemble *spatifolia* or are intermediate between *fendleri* & *spatifolia*

Morphology: (*fendleri* × *spatifolia*) × *texana* (FST)

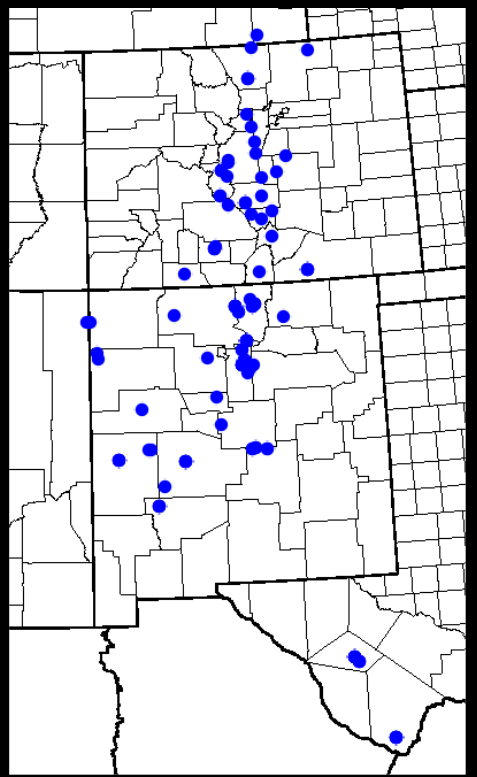
- plants intermediate between all three species

Conclusion:



Further research:

- more individuals of *texana* are being added;
- further hybrid lineages in *B. fendleri* sensu lato remain to be addressed.

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